UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE OFFICE OF LAND AND WATER RIGHTS WATER RIGHTS SECTION SAN FRANCISCO, CALIFORNIA

HYDROLOGIC INVESTIGATION OF UPPER AND LOWER EMIGRANT SPRINGS

AT

DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA

Ву

Gerard S. Witucki

Administrative report for U.S. Government use only

February, 1968



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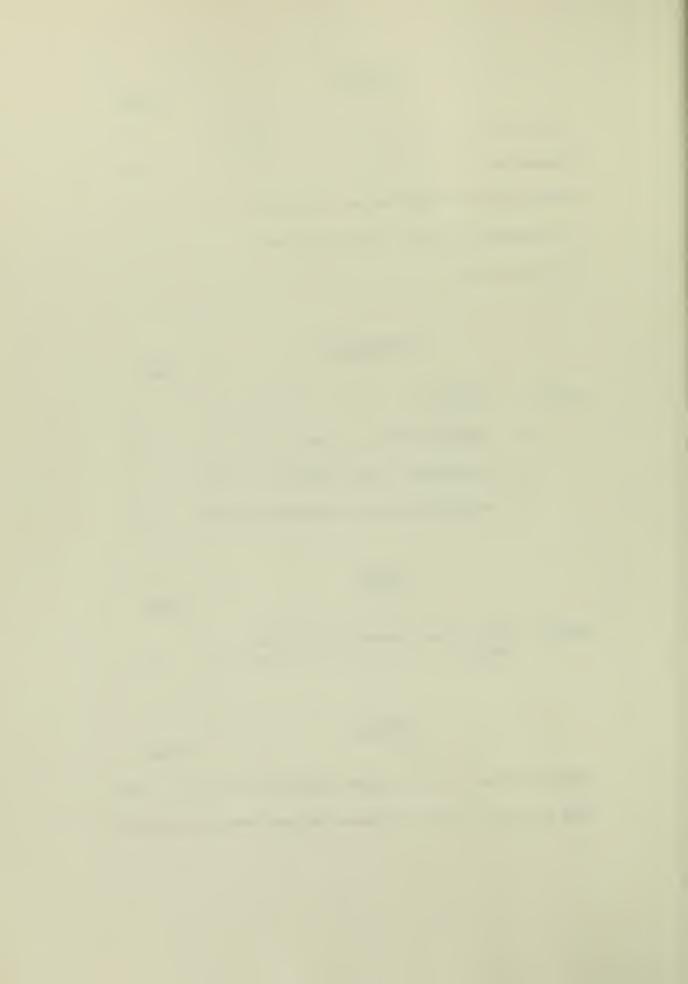
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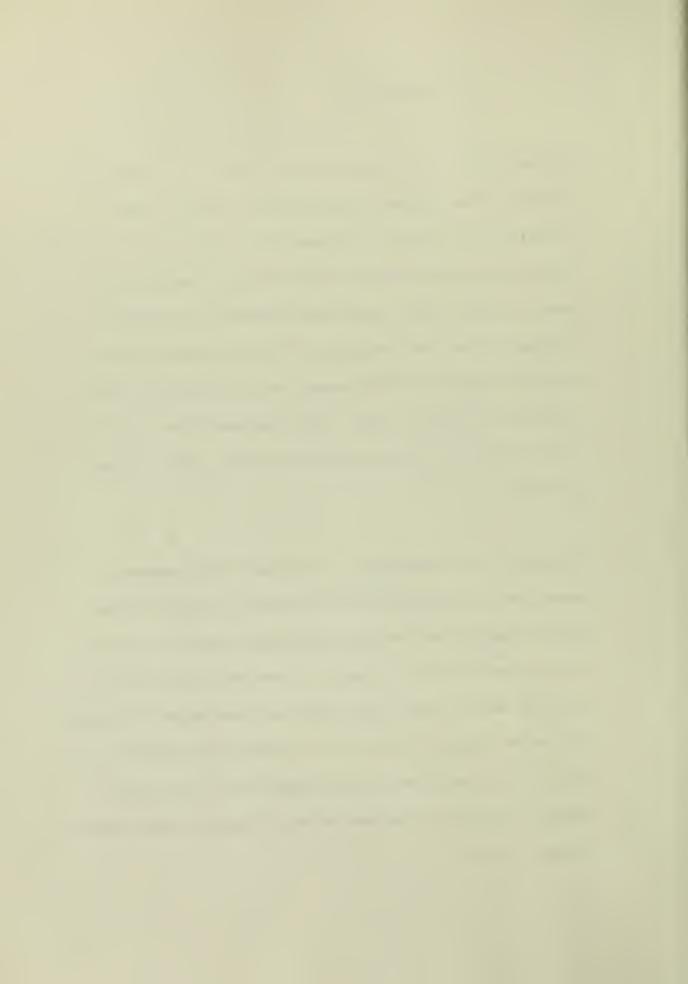
I - INTRODUCTION

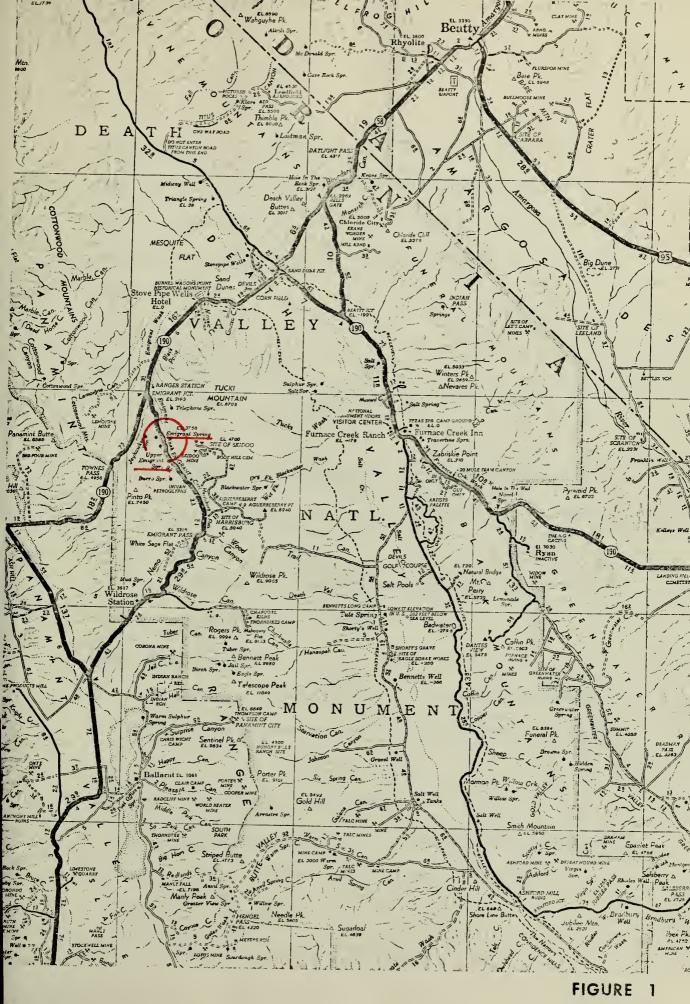
The need exists for an increased water supply for the Emigrant District at Death Valley National Monument (Morris, 1966).

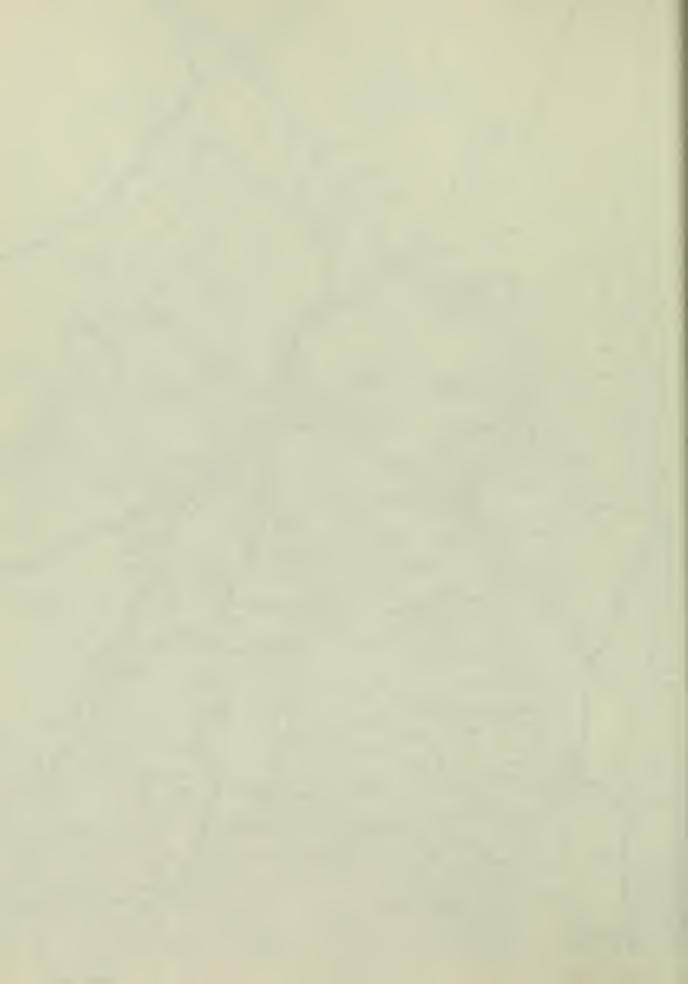
This situation is further complicated by the existing water right of 700 gallons per day at Lower Emigrant Springs by the Stove Pipe Wells Hotel organization (General Hotel Company).

It appears likely that the owners of the facilities at Stove Pipe Wells Hotel may wish to expand their facilities and hence increase their need for water. The organization has unsuccessfully attempted to drill a potable water well closer to their facilities.

Geological Survey Hydrologist F. F. Zdenek (1966) prepared a report for the National Park Service which described a number of small springs which he felt could be put together to make up the above-mentioned water supply. It was felt that the best potential sources would be the Upper and Lower Emigrant Springs. This report presents the results of an investigation made as an aid in the determination of what further steps can be taken to increase the amount of captured water at Upper and Lower Emigrant Springs (see Fig. 1).







After reviewing applicable reports, visiting the specific sites (see Fig. 2), and holding preliminary discussions with Superintendent J. Stratton and Chief of Maintenance T. Boothroyd, at Death Valley, the following collective recommendations were made (Witucki, 1967):

Upper Emigrant Springs

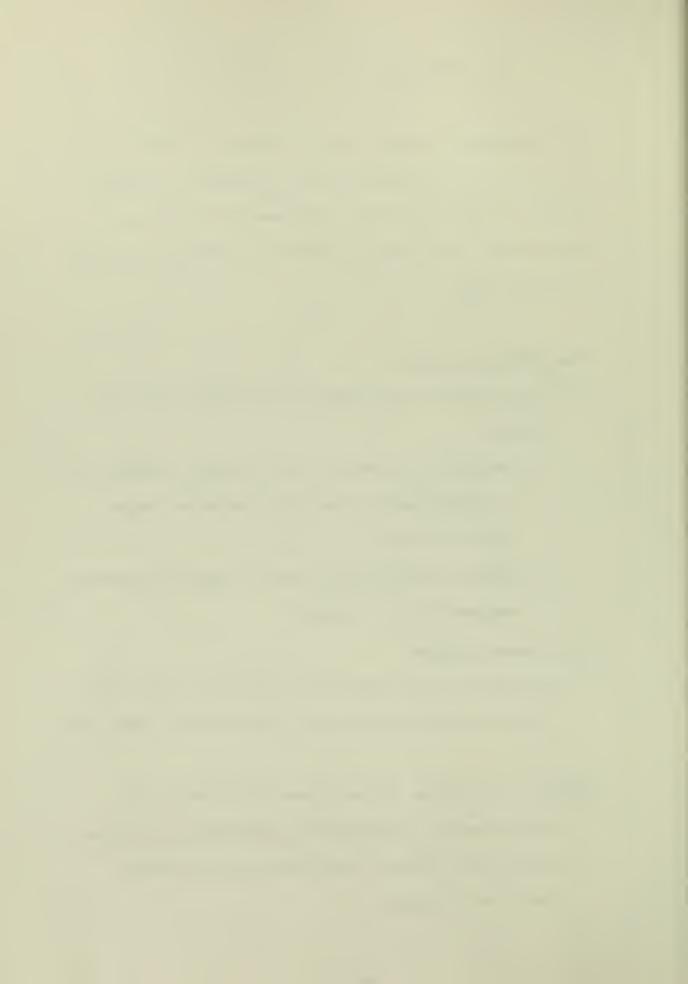
- Drill or auger as many borings as practicable through the alluvium.
 - A. Borings at this location may be somewhat troublesome due
 to the coarseness of the gravel (cobble and boulder
 sizes are common).
 - B. Borings at this location should be done with mechanized equipment if at all possible.

Lower Emigrant Springs

 Drill or auger as many borings as can be practicably accomplished. The gravels here do not contain as many large sizes.

Hopefully, the borings will contribute the following data:

- 1. Depth to bedrock; Configuration of the subsurface alluvium.
- Depth to water; General configuration of the saturated portion of the aquifer.



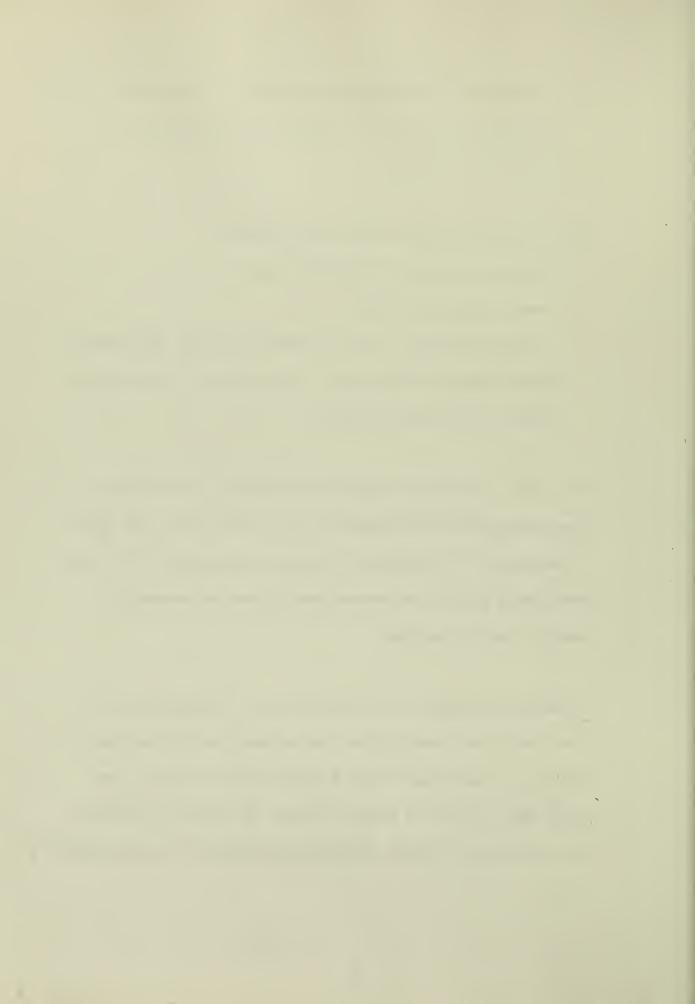
3. Description of the material encountered - in that this information will be useful if an extensive infiltration gallery should be installed.

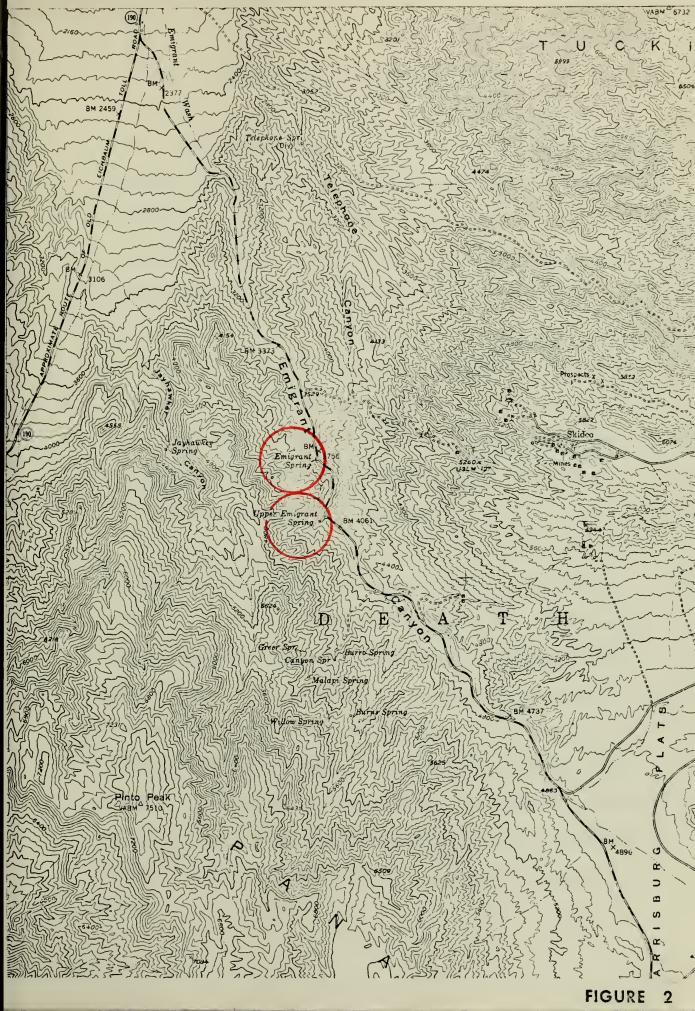
The following drilling methods were considered:

- 1. Mechanized augering (continuous flight).
- 2. Rotary drilling with air.
- 3. "Chicago Pneumatic" This is similar to an air jack-hammer; miners often use this method. It produces a 2-inch diameter boring and is fairly portable.

The relief of the terrain about these springs, particularly at Lower Emigrant, varies sharply and was a factor as to the choice of equipment. It was decided to choose the equipment that would most nearly produce the desired data without an unreasonable amount of effort expended.

It had been intended to do some backhoeing. Unfortunately, at the time of the investigation, the equipment was not available. It had also been hoped to run a simple seismic survey at the Upper Emigrant site to verify the depth to bedrock as indicated by the augering; however, untimely equipment malfunction prevented this.



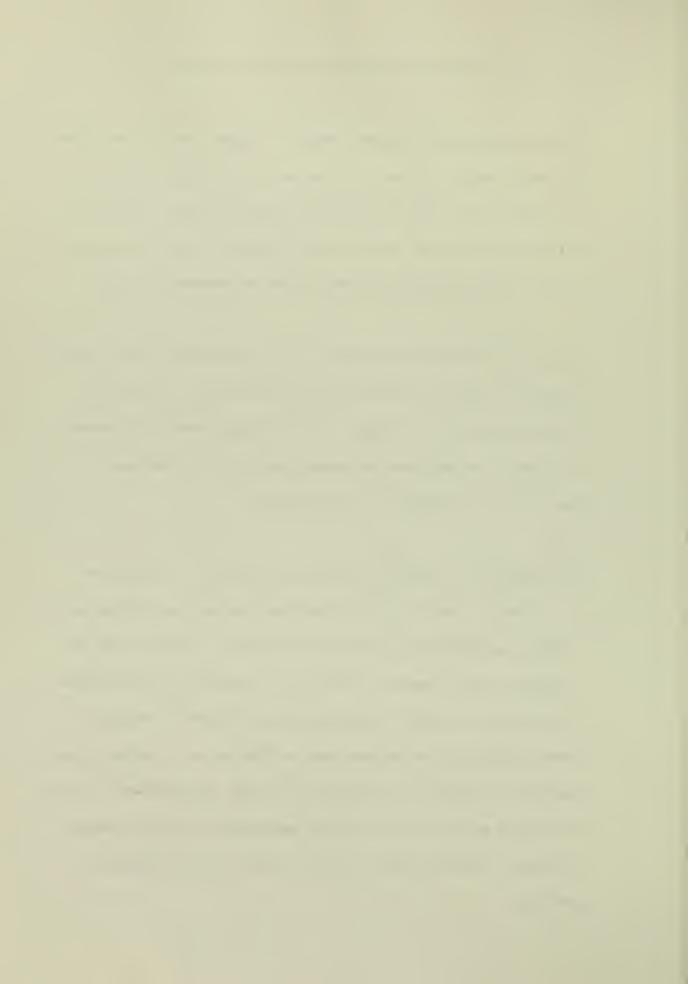




A four-inch mechanized auger (continued flight) was borrowed from the Naval Weapons Station at China Lake, California, as it was not possible to obtain satisfactory boring equipment from local drilling contractors. Three to four inches of snow fell on sites prior to the investigation, which began on December 18, 1967.

An arbitrary datum was selected at the intersection of the center of Emigrant Canyon Road and the projected axis of the canyon (assumed elevation of 0 feet). The 19 boring sites were located in relation to this selected datum (see Fig. 3). The logs of the borings are attached in the Appendix.

By examining the logs, it is seen that borings 1 - 6 vary from 2 to 5 feet in depth. Although boulders rather than bedrock were probably encountered in some of the borings, it appears that the alluvial cover is somewhat thin here. Borings 7 and 9 indicated a thickening of alluvium and the presence of water. Boring 8 seems to indicate the western edge of the aquifer. Boring 10 may indicate the bedrock of the eastern edge of the alluvium. Borings 12, 13, 14 and 15 to the north of the abandoned well all indicate moisture. Maximum depths of alluvium were found at borings 9 and 14.



Boring 16 drilled in an associated drainage, at what visually appeared to be the maximum depth of alluvium there, indicated alluvium to a depth of about four feet without any sign of moisture.

Borings 17, 18 and 19 drilled in the narrowest part of the canyon indicated a relatively shallow cover of alluvium which was saturated near the surface. Water generally runs on the surface near boring 19.

Upon completion of the borings, two-inch steel pipes (lower two feet perforated) were set in four selected borings: 9, 11, 12 and 13. Water measurements were made on the following day in these borings and also in the others, indicating moisture (see Table 1).

Conclusion and Recommendations

The boring logs reflect the general configuration of aquifer and its saturated portions. However, as pointed out, it had snowed 3 to 4 inches and the melting snow was presently contributing to the water table in the alluvium. It is felt that the borings generally indicate where the lower portions of alluvial covered bedrock occur. If required, a somewhat general isopachous map could be drawn based on the data, so as to reflect a general



indication of aquifer storage. The depths to water reflected by this investigation in combination with a continuous sounding program of the four cased wells should give an indication of the fluctuations of the water table throughout the year as well as an indication of the hydraulic gradient.

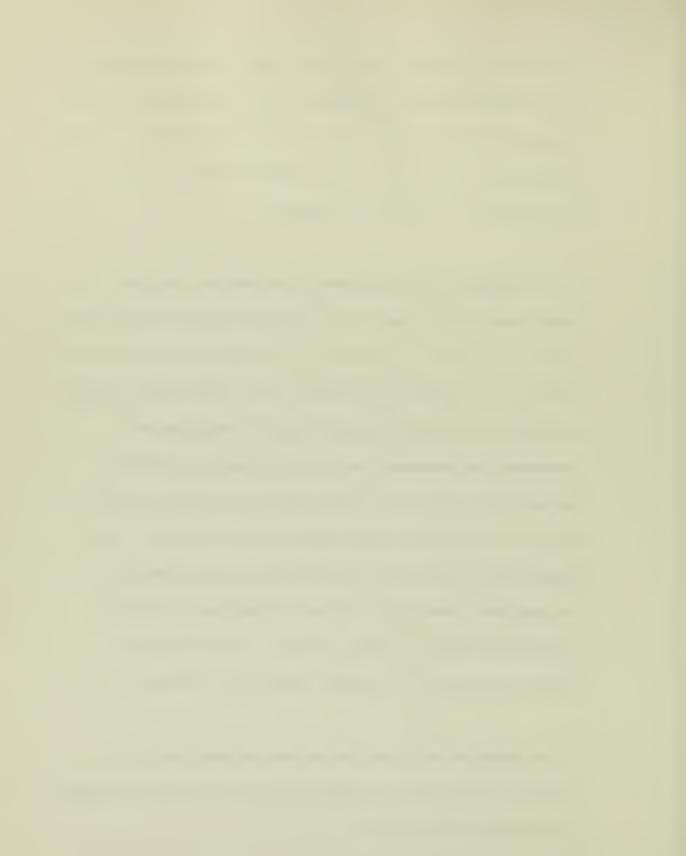
It is suggested that an impermeable boundary be installed (i.e., cement keyed walls, grout, etc.) somewhere between the outcrops from A to B of Fig. 3, depending on the economics of the installation, so as to utilize the alluvial cover as subsurface storage.

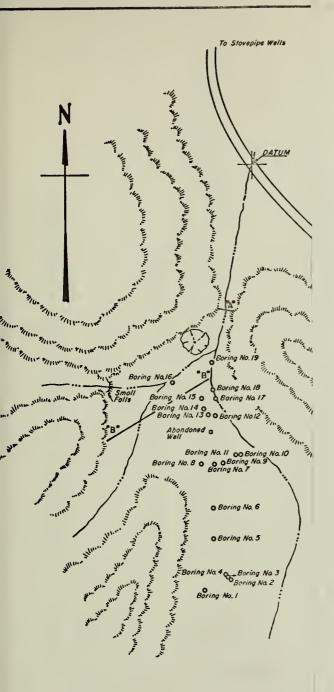
Although an impermeable barrier right at A would be more economical than anywhere from A to B, it may be possible to capture more water with a barrier toward B, as some water may be lost to underflow in the bedrock before it reaches A. Mr.

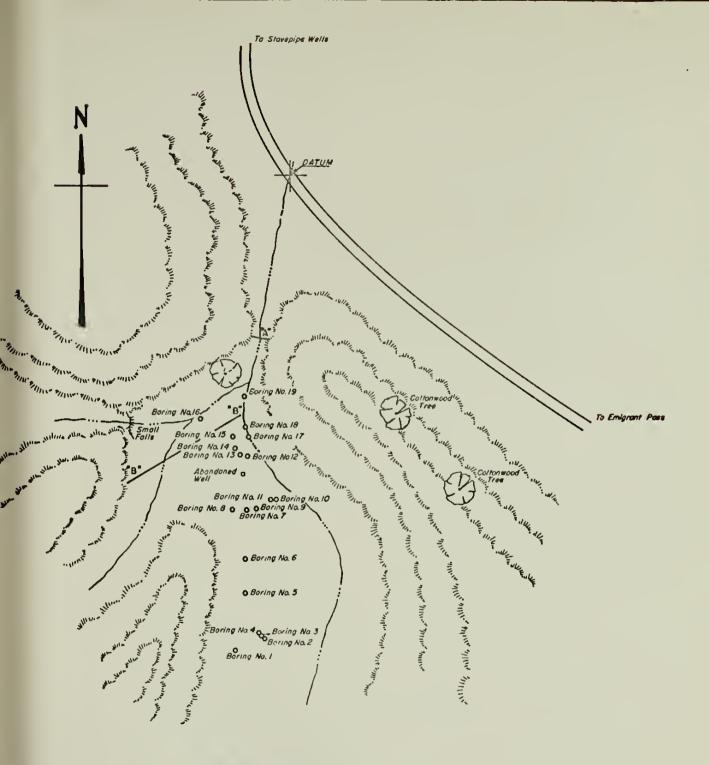
Glen Miller of USGS plans to make some flow measurements at A and make some comparisons with the fluctuations of the water table reflected in the cased borings. This may give some general indication as to whether underflow is occuring.

It is suggested that a backhoe be used to investigate the alluvium prior to making a determination as to the best location .

of the impermeable barrier.







Boring No. 1 - Elev. 109.0', Total depth 5', Dry Boring No. 2 - Elev. 104.0', Total depth 5', Dry Boring No.3 - Elex 104.0', Total depth 2', Dry Boring No.4- Elex. 104.0', Total depth 2.5', Ory Boring No. 5 - Elev. 97.0 , Total depth 2', Ory Boring No. 6 - Elev. 91.0 ', Total depth 5', Dry Boring No. 7 - Elev. 74.0', To:ol depth 9.5', Signs of moleture at 6.5' Boring No. 8 - Elev. 77.0', Tola. depth 5', Dry Boring No. 9 - Elex. 73.0', Total depth 14', Cased 9' below surface, 2' of standing water before casing on Dec. 21. Boring No. 10-Elex 73.0', Total depth 5', Dey Boring No. 11 - Elev. 71.0', Total depth 7.5', cased 9.5' below surface, 2.5' of standing water after drilling on Dec. 20. Boring No. 12 - Elev. 64.0', Total depth 4', Cosed 3.5' below surface, 02' of standing water after drilling Boring No. 13 - Elev 61.0', Total depth 7.0', Cosed 7' below surface, 05' of standing water offer drilling Boring No. 14-Elev. 60.0', Total depth 10', Signs of maisture at 7.5' Boring No. 15 - Elev. 60.0', Total depth 7', Signe of moleture at 6' Boring No. 16-Elev. 59', Total depth 4', Dry Boring No. 17-Elev. 55', Total depth 4' Saturated at 1', 2' at standing water offer drilling Boring No. 18 - Elsv. 54', Total depth 5', Saturated at 0.5', 1.5' of standing water of Boring No. 19 - Elev. 45', Total depth 2'. Saturated all the way down

HALF-SIZE REPRODUCTION

DATUM = 0' ELEV. (ASSUMED) SCALE 1°= 100'

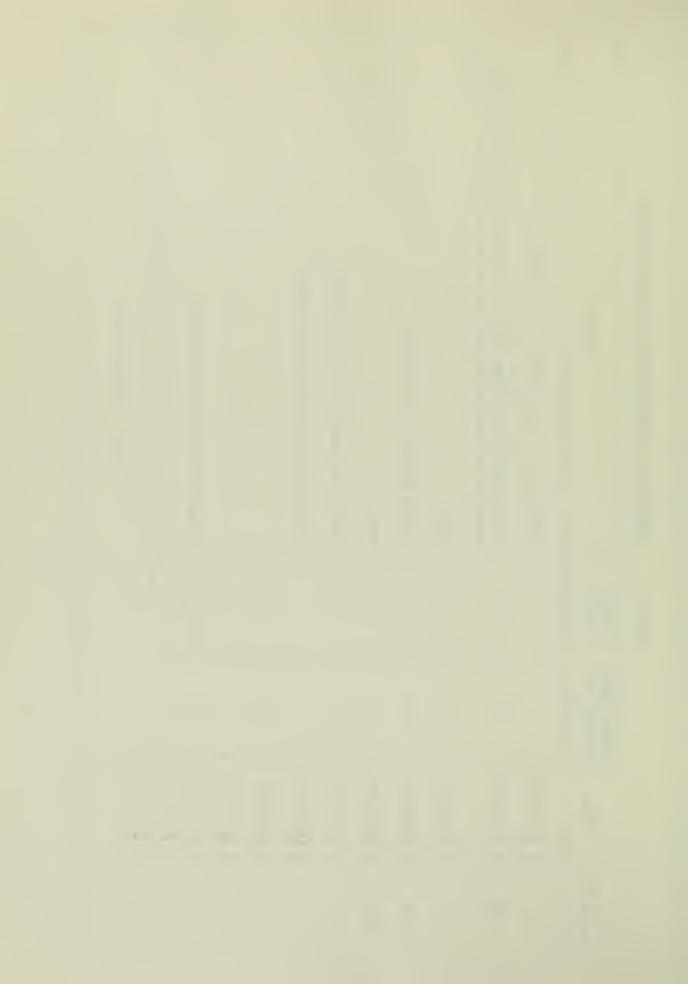
PLOT PLAN

Boring Locations-Upper Emigrant Springs
DEATH VALLEY NATIONAL MONUMENT

TABLE 1 - SOUNDINGS OF THE BORINGS INDICATING MOISTURE

Remarks	Boring was caved on the 21 of December.	This sounding was taken prior to setting 9' of casing. No sounding was made after setting casing as water was not stable.	None.	Boring caved 0,5' overnight.	None.	Boring was caved on 21 of December.	Boring was caved on 21 of December.			Saturated from the surface down.	
Depth to Water	-	12	52	63	6			5	1.5	Surface	riginis emphalis apu proprio es diferent elles establistes
Total Depth at Date of Sounding		14.	7.5'	3,51	7.			.	÷ m	Ø.	
Date	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	12/21/67	
Boring No.	7	o. *	*	* 12	13. *	77	15	71	18	. 19	

* Note - Cased Borings



Because of the steep relief, it was not possible to use the mechanized auger here. Therefore, the pneumatic-type drill equipment provided by the Park's maintenance force was used.

Zdenek, in his report (1966), discussed the possibility of the base of the aquifer being in the fractured bedrock underlying the alluvium at this site.

It was not possible to get up to the elevation where the present collection system is installed because of the length of the air hose in relation to position of the air compressor. Two boring sites were located in an eroded natural drainage channel above an old mine opening (see Fig. 4). Visually, it appeared that stratigraphically the sites were located at the contact of the alluvium with the bedrock (green felsitic igneous intrusive - probably a dike).

Similarly as at Upper Emigrant Springs, an arbitrary datum was selected at the intersection of the center of Emigrant Canyon Road and the projected axis of the canyon (assumed elevation of 0 feet). Boring sites were located in relation to this selected datum (see Fig. 4). The logs of the borings are attached in the Appendix.



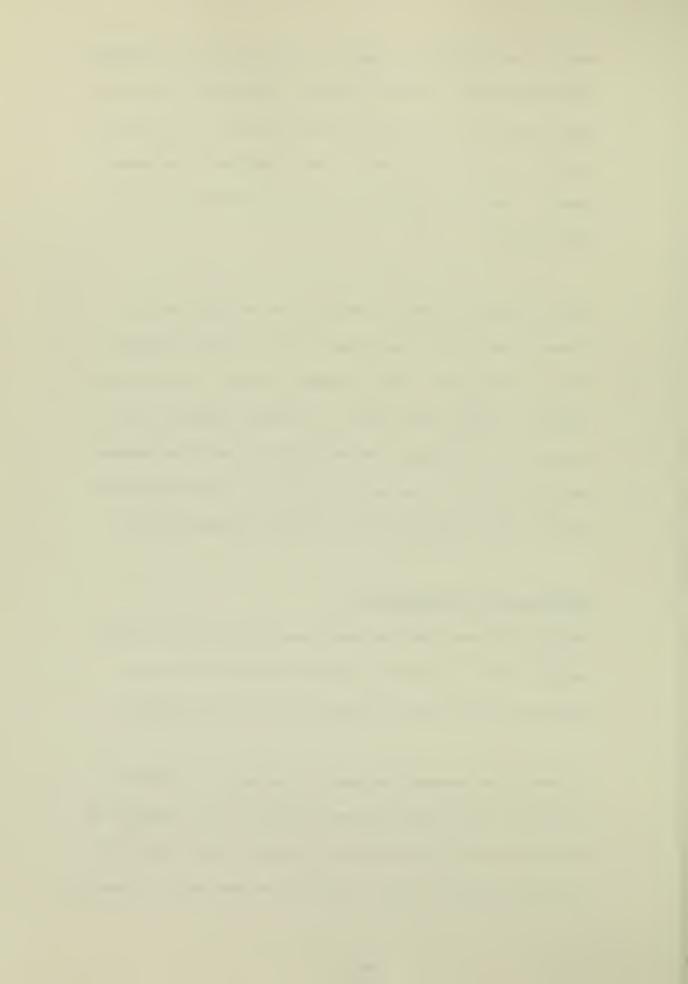
Boring 1 met refusal at a depth of three feet, and the cuttings reflected weathered bedrock. Boring 2 had to be drilled at an approximately 45° angle with the ground surface to facilitate handling the equipment. Most of the boring was in weathered bedrock. Water which flowed was first encountered at $3\frac{1}{2}$ feet (slant depth).

The drilling was halted for about an hour at approximately 4 feet (slant depth); the boring filled to a few inches from the top in this time. After resuming drilling, the boring met refusal at 9 feet (slant depth). Two small streams of water appeared to be flowing in the boring at 3.5 and 6' at approximately 1/10 GPM. At the end of four hours, the boring filled almost to the surfact but did not flow and appeared static.

Conclusion and Recommendations

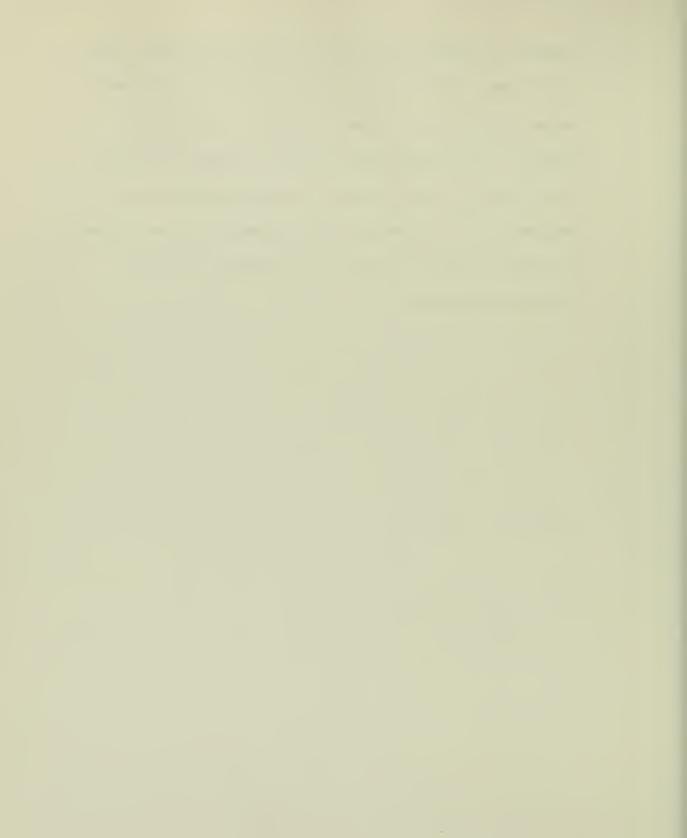
Boring 2 indicated that the water does occur in the fractured bedrock. So, in order for a collection system to be most effective at this site, it should be put into the bedrock.

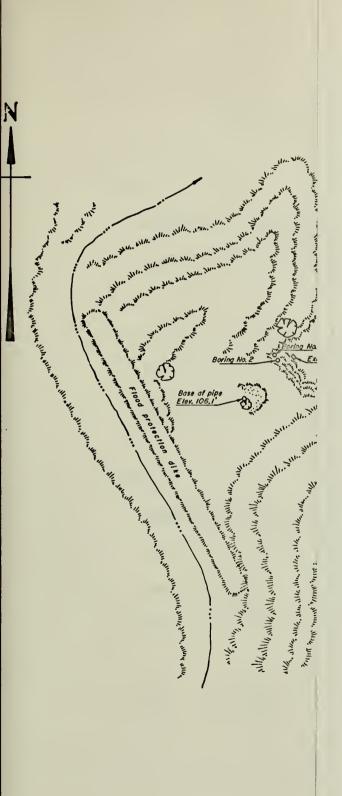
In view of the apparent attitude of the igneous intrusive in relation to the alluvium and the older host rock, there may be water held back of the intrusion, possibly directly below the existing collection system. There may be some merit in obtaining



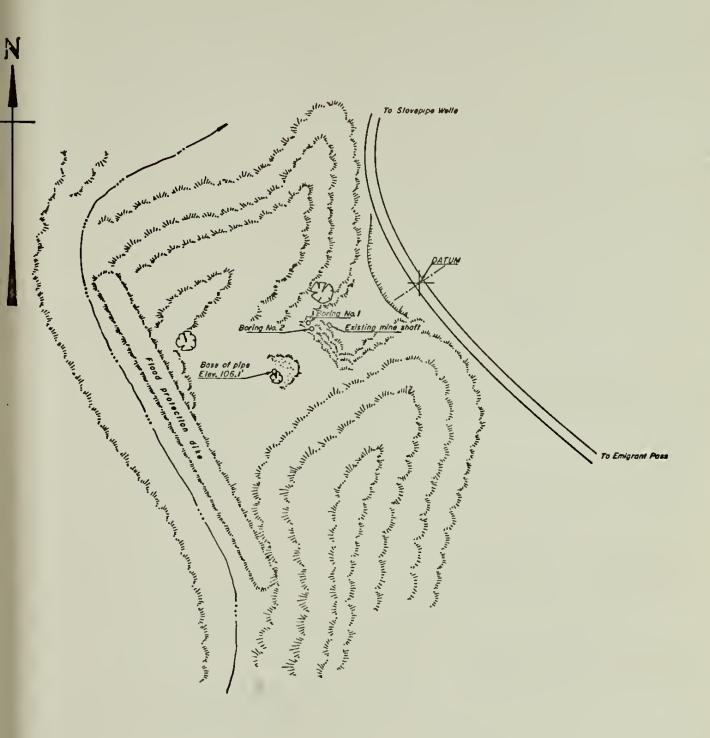
pneumatic equipment that could drill to the approximate depth of 100 feet, which could be utilized in drilling a horizontal boring located somewhat lower in elevation than boring 2.

Hopefully, this boring would intercept any water held behind the intrusive in either or both the alluvium and the older intruded rock. If successful, this approach could be expanded and would eliminate the need for an expensive collective system in the bedrock.





L.Sando, Feb. 15, 1968



Boring No. 1 - Elev. 61.0', Total depth 3', Ory Boring No. 2 - Elev. 61.0', Total stant depth 3', Water at 3.3' and 6'.

HALF-SIZE REPRODUCTION

DATUM = 0' ELEV. (ASSUMED)
SCALE 1'= 100'
PLOT PLAN
Boring Locotions - Lower Emigrant Springs
DEATH VALLEY NATIONAL MONUMENT

REFERENCES CITED

Morris, M. - 1966

Memorandum to Assistant Director, Specialized Services (June 6, 1966), Stovepipe Wells.

Witucki, G. S. - 1967

Field Trip Report on Death Valley National Monument,
Inclusive dates of travel: 11/27 - 11/29, 1967.

Zdenek, F. F. - 1966

Memorandum to Supervisor, Death Valley National Monument (February 18, 1966). Information - Examination of one proposed well-site and eleven potential spring developments in the Death Valley National Monument, California.

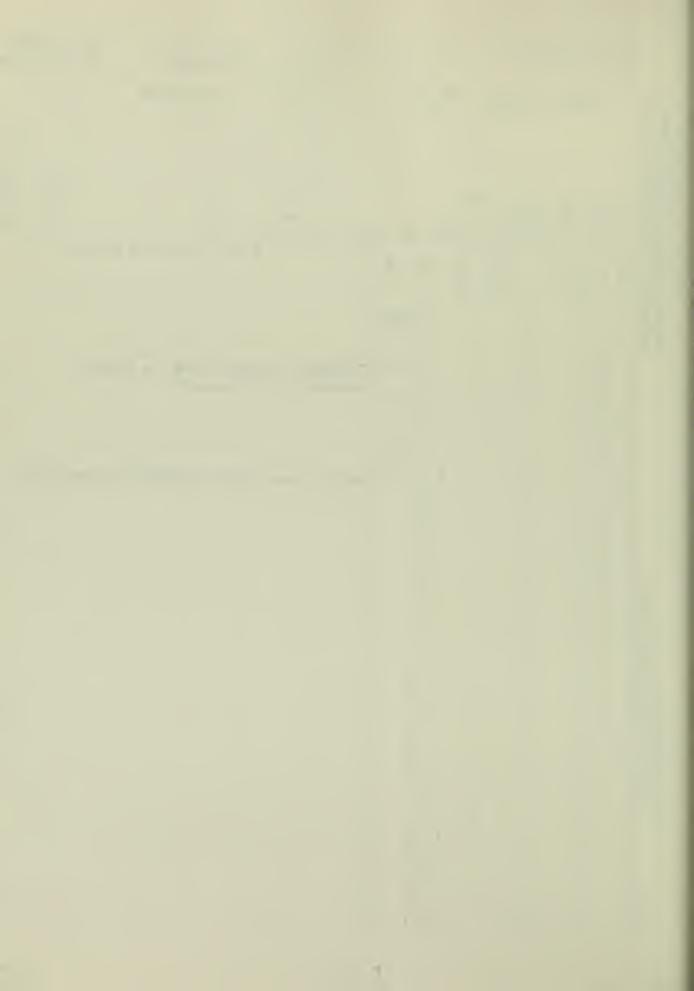


APPENDIX

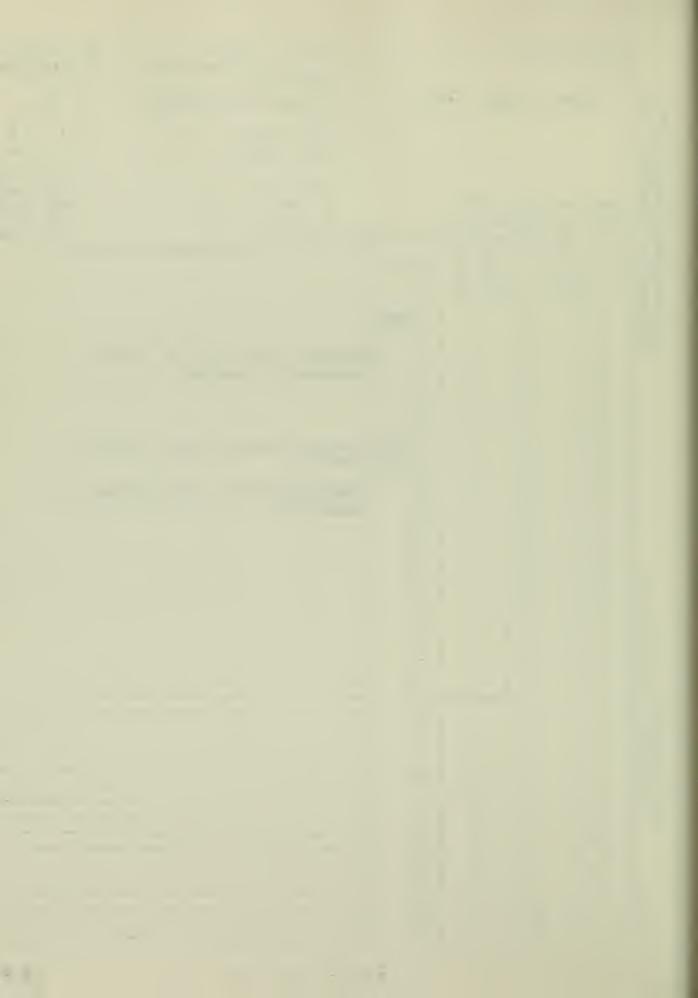


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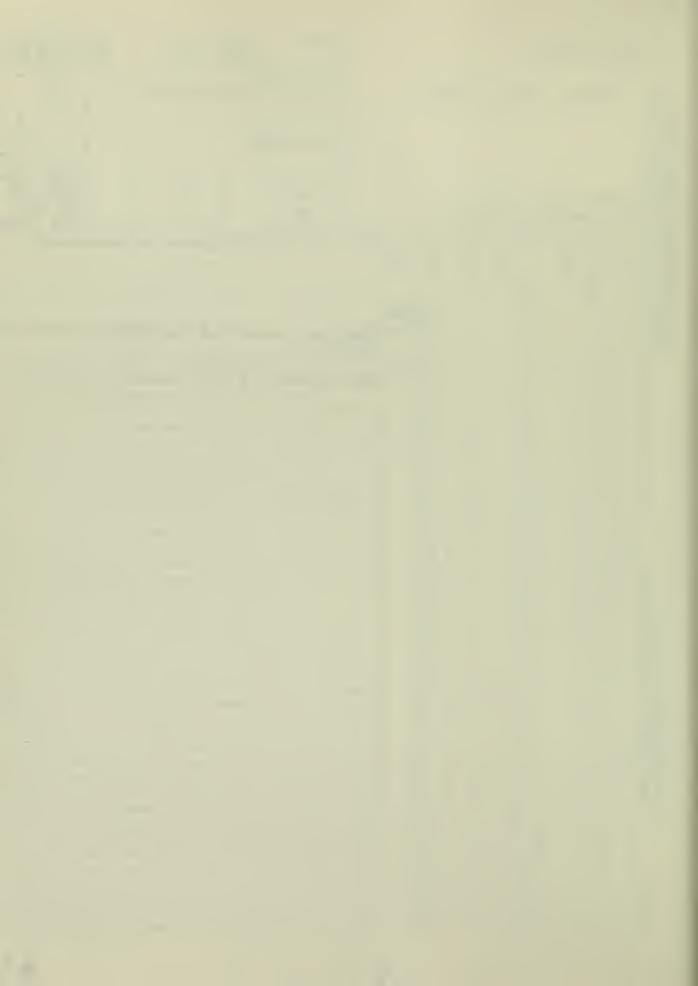
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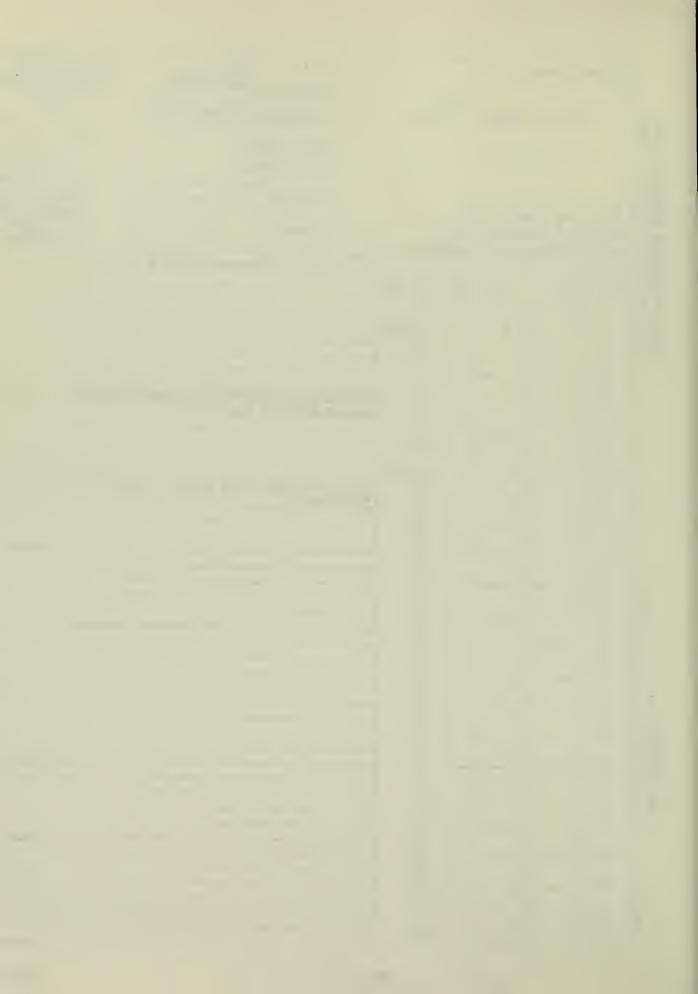
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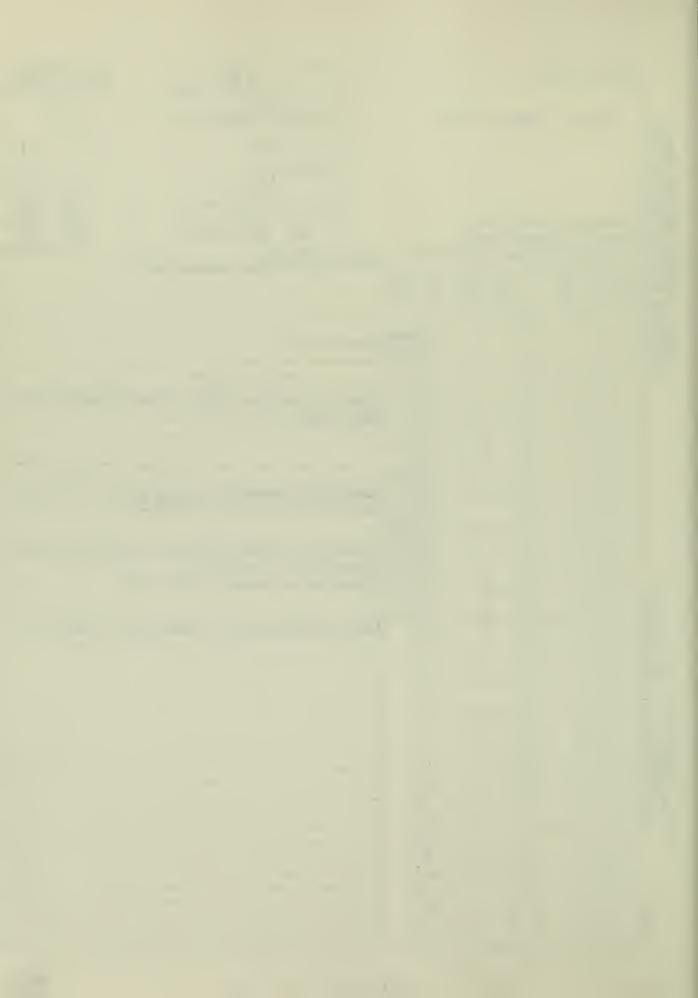
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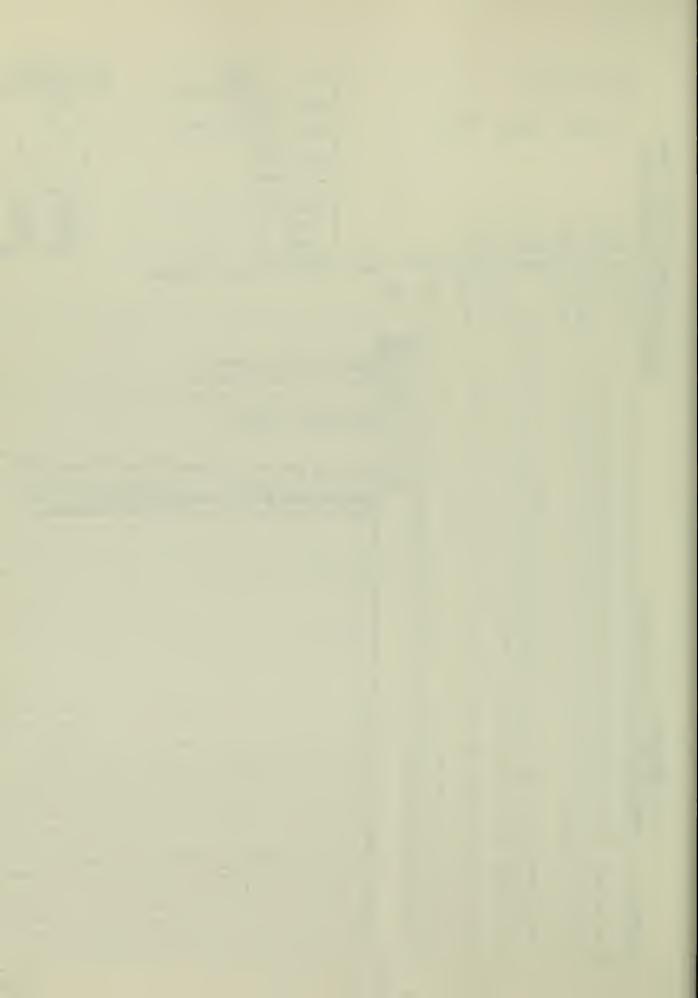
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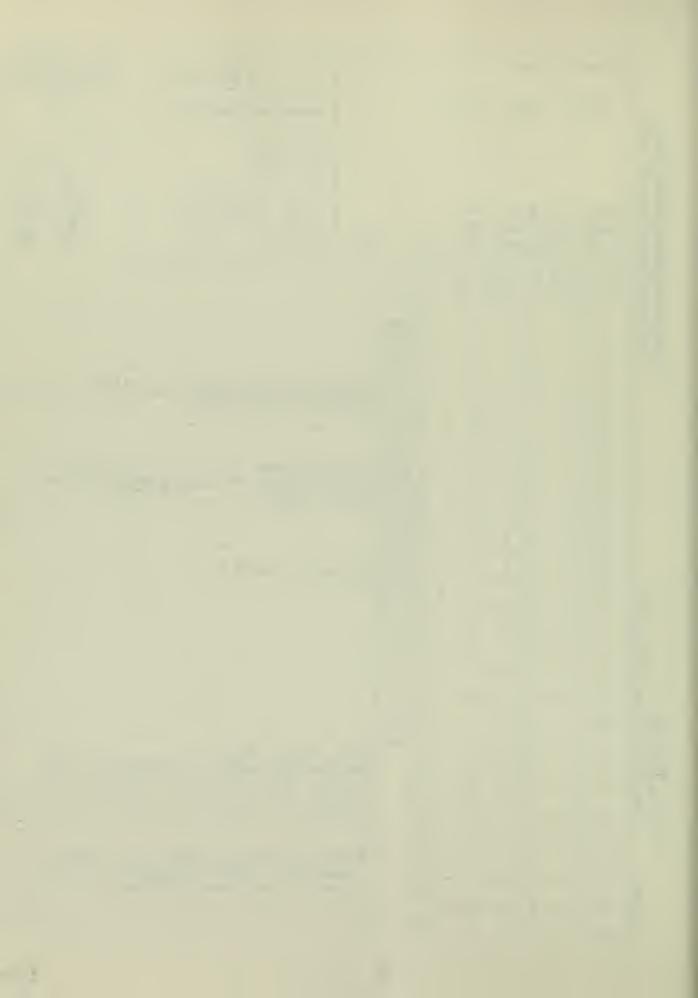
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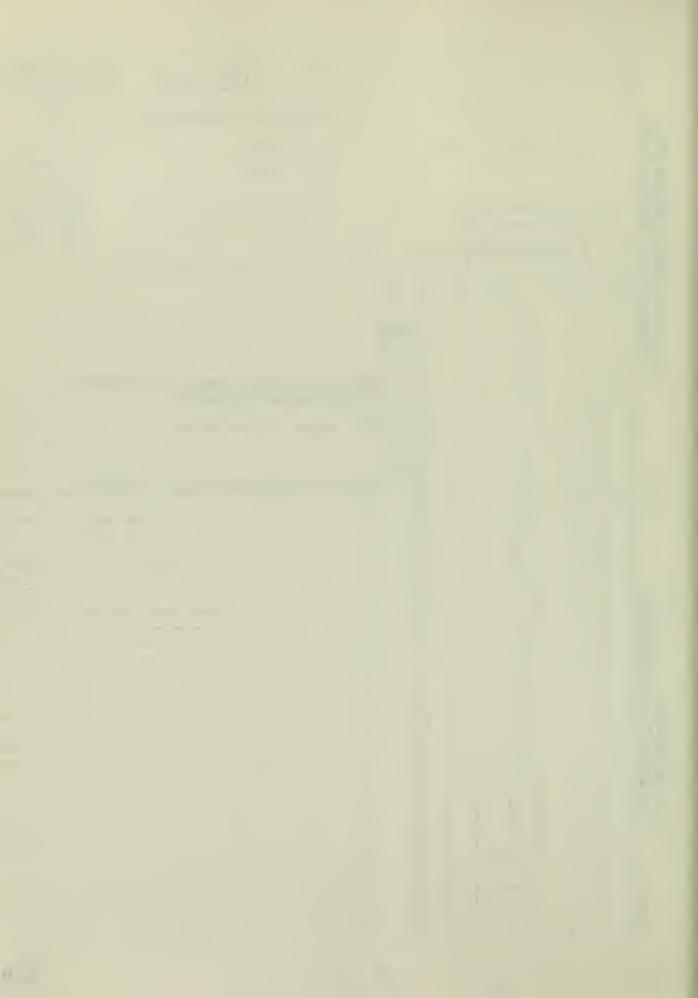
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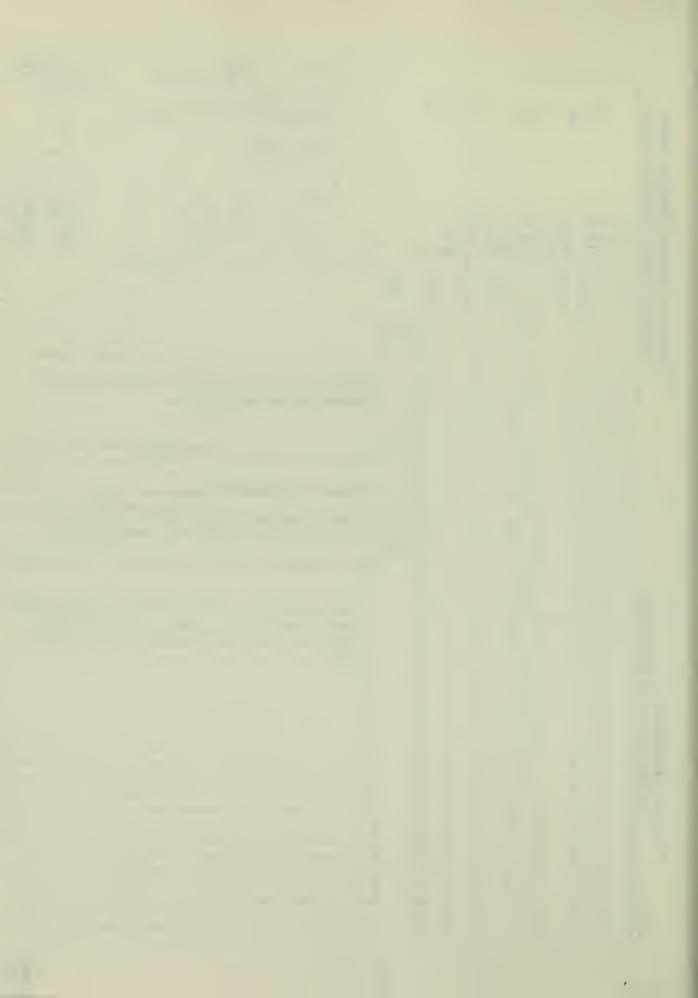
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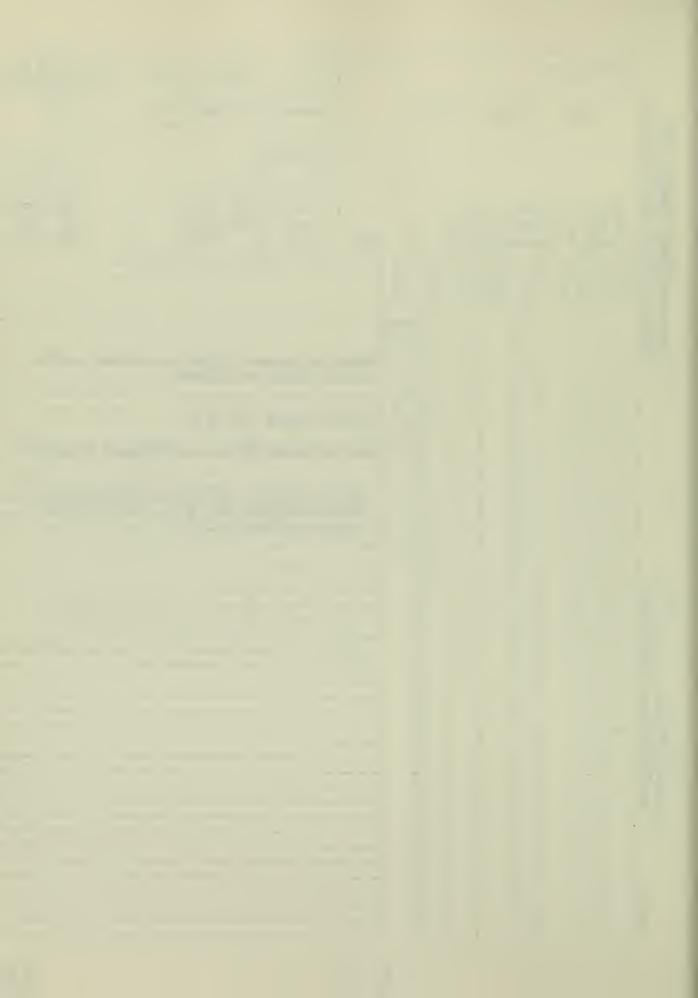
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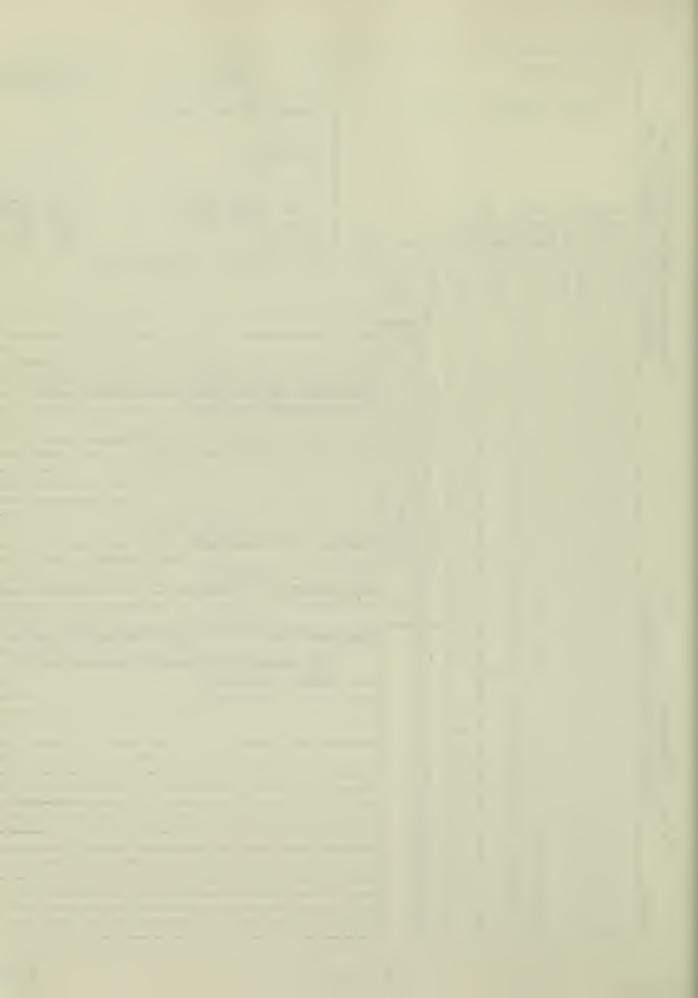
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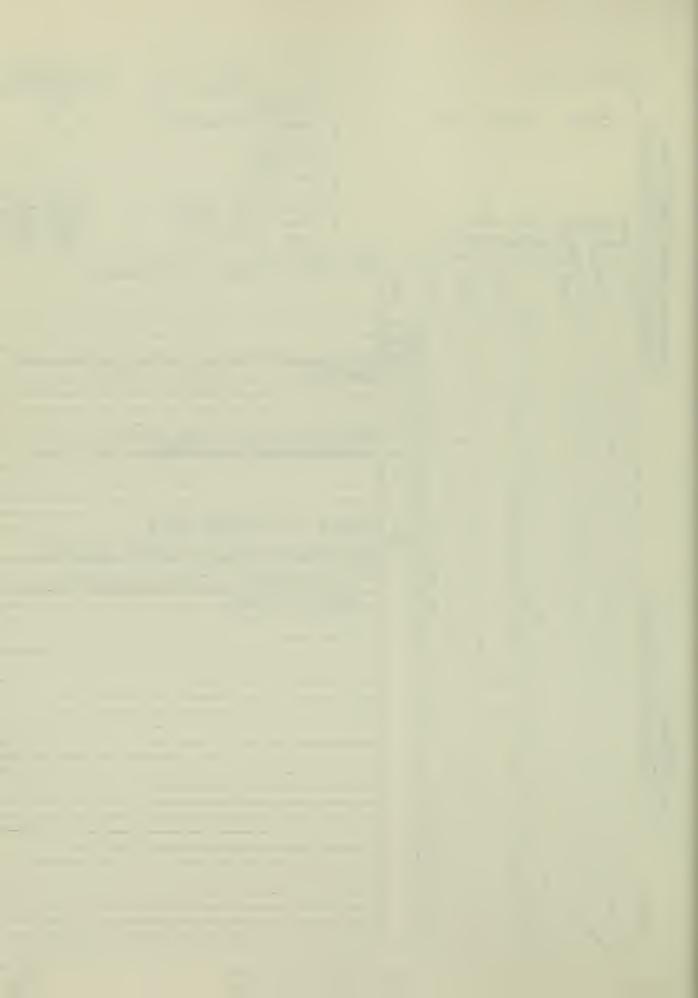
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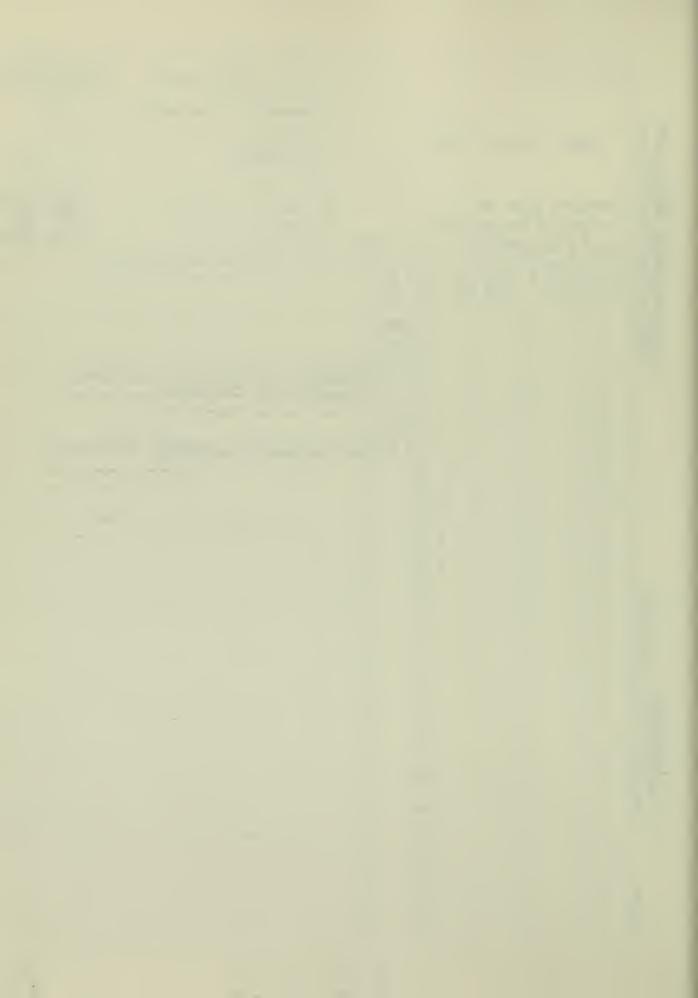
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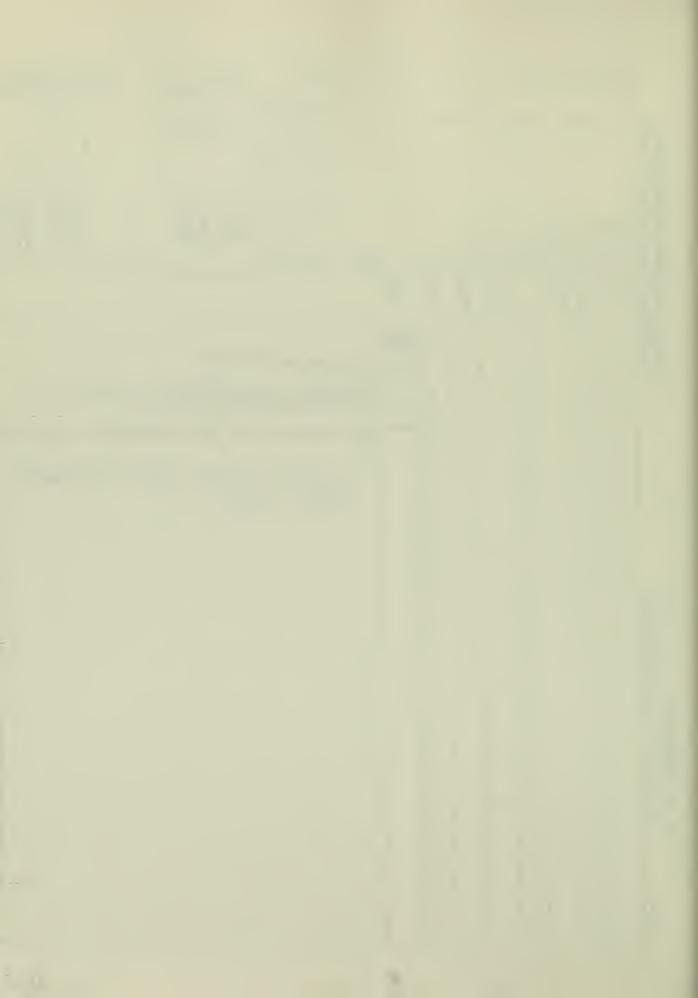
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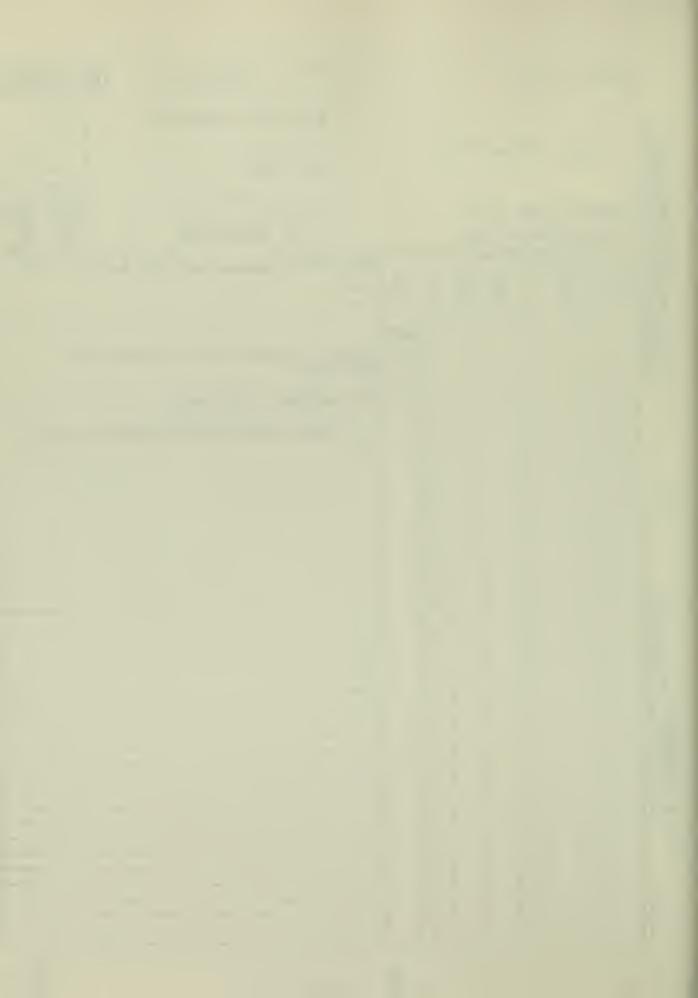
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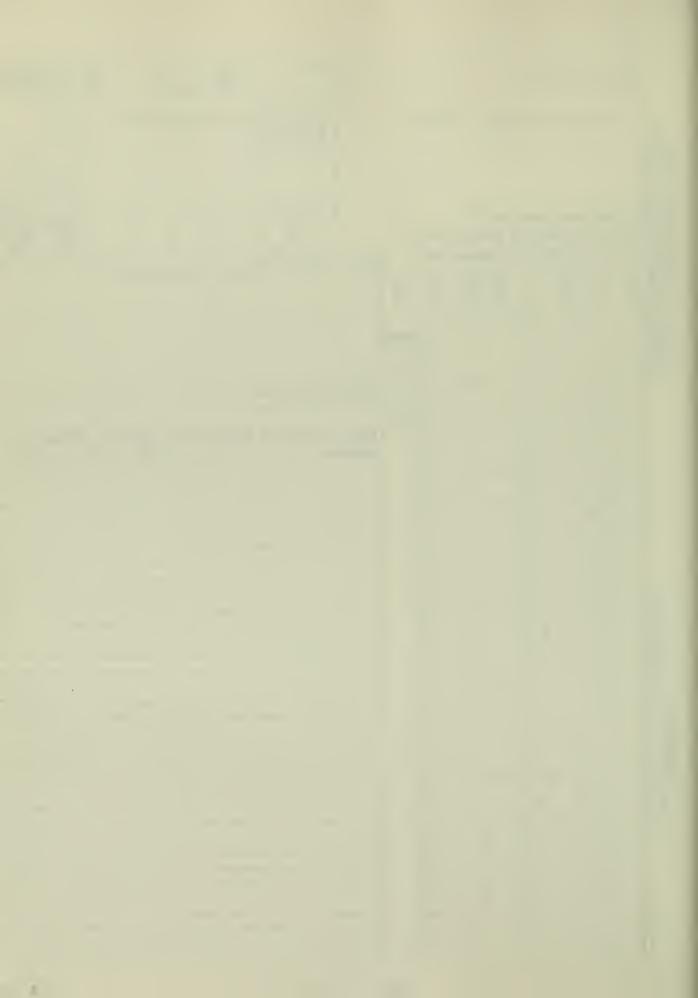
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